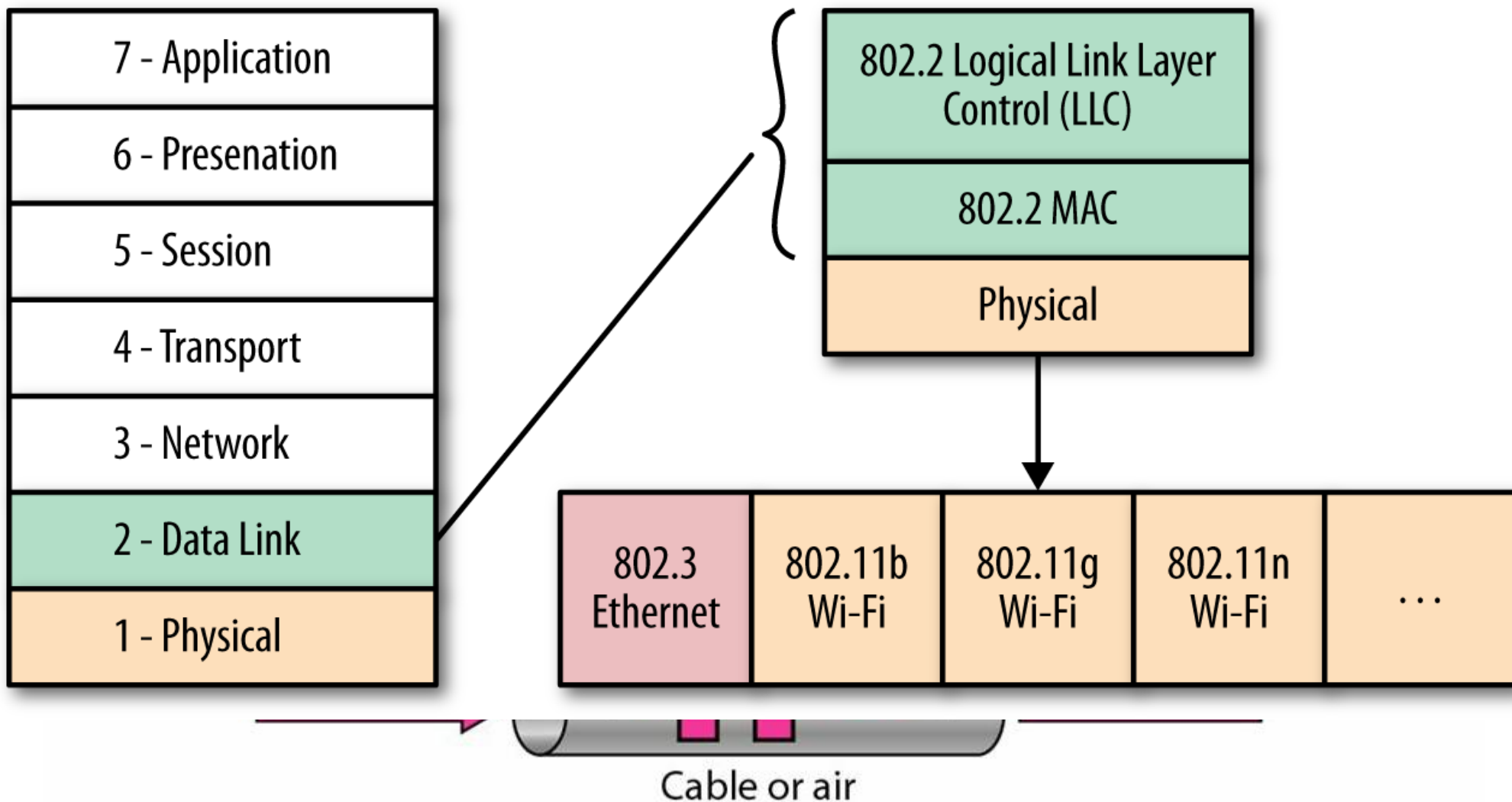


无源通道建模 及仿真测试校准

01

高速设计挑战及通道的要求

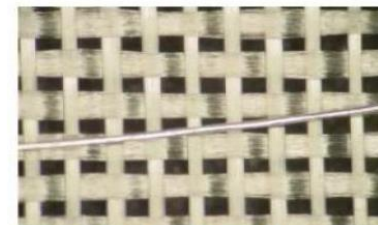
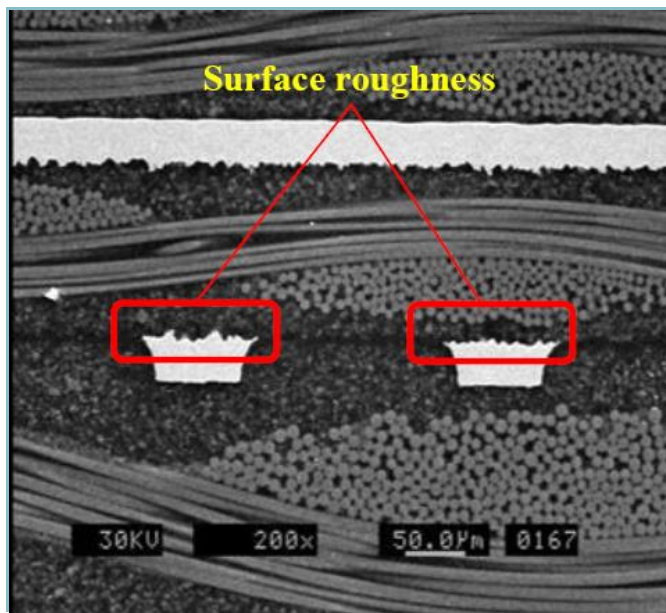


典型的1/4波长

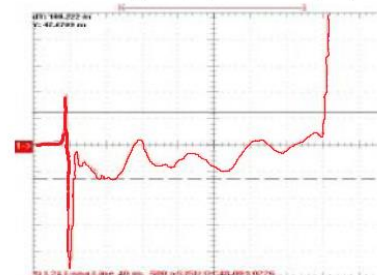


高速时代下，无处不在的“蚂蚁”

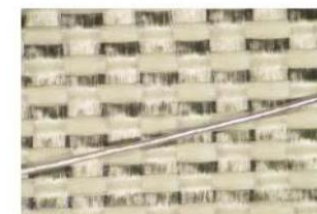
- 玻纤效应
- 铜箔粗糙度
- 各种加工偏差
- 防不胜防的“Stub”
- 不可忽视的走线细节
- 阻抗、阻抗、阻抗



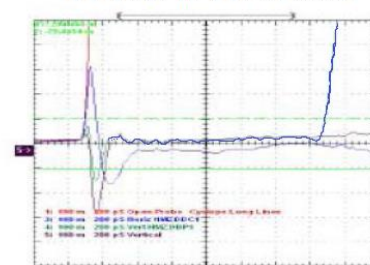
1080玻纤布 (3.5mil线宽)



用1080的阻抗线



3313玻纤布 (3.5mil线宽)



用3313的阻抗线



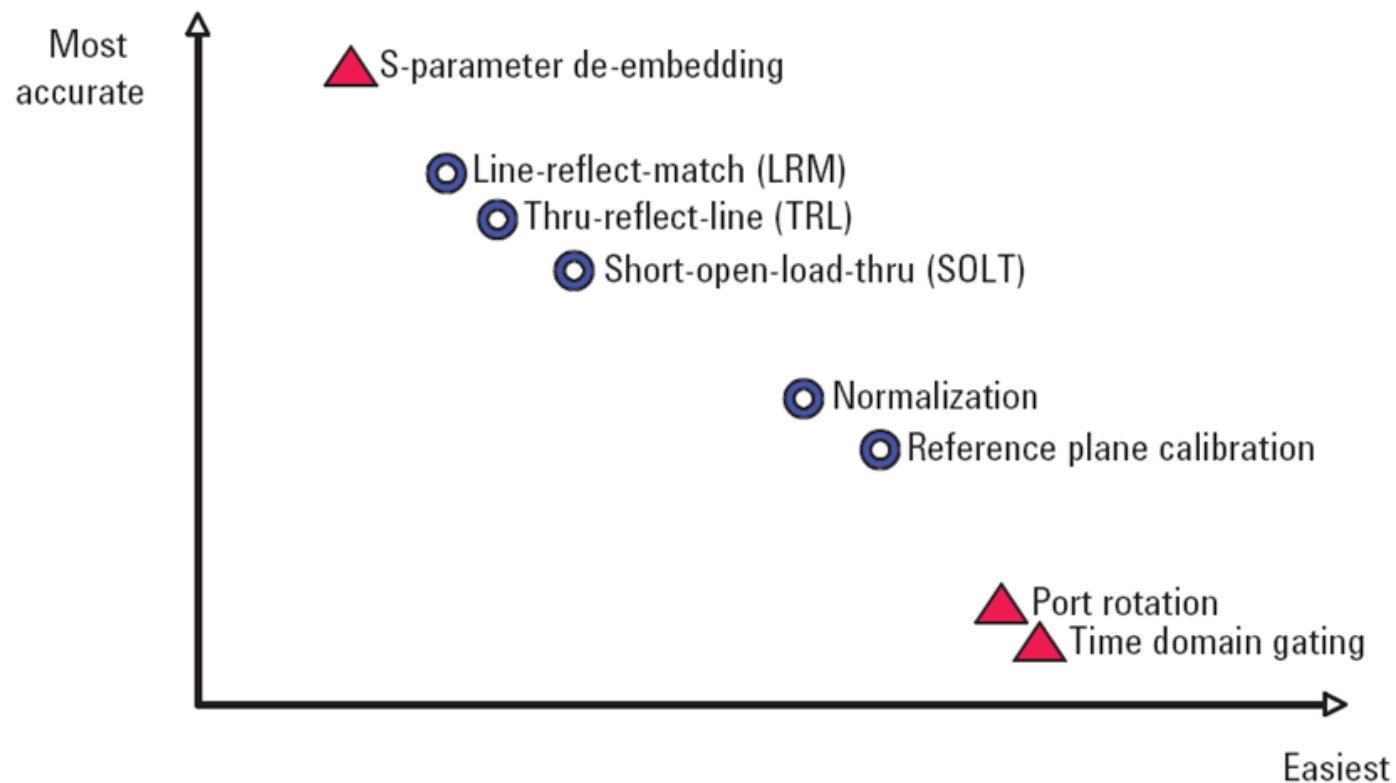
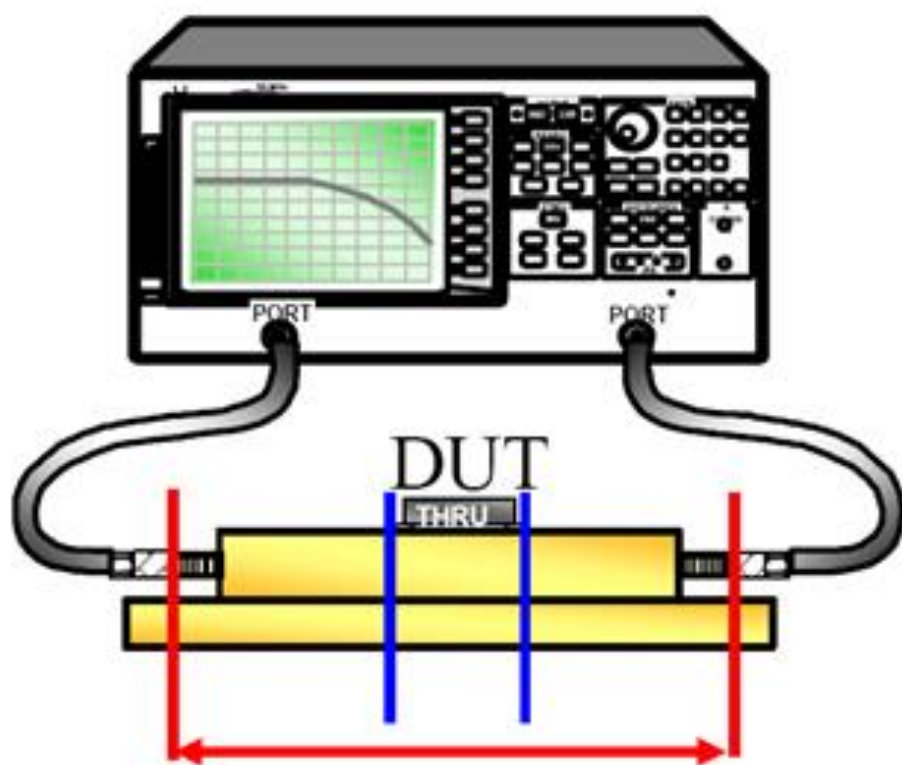
我们怎么办？



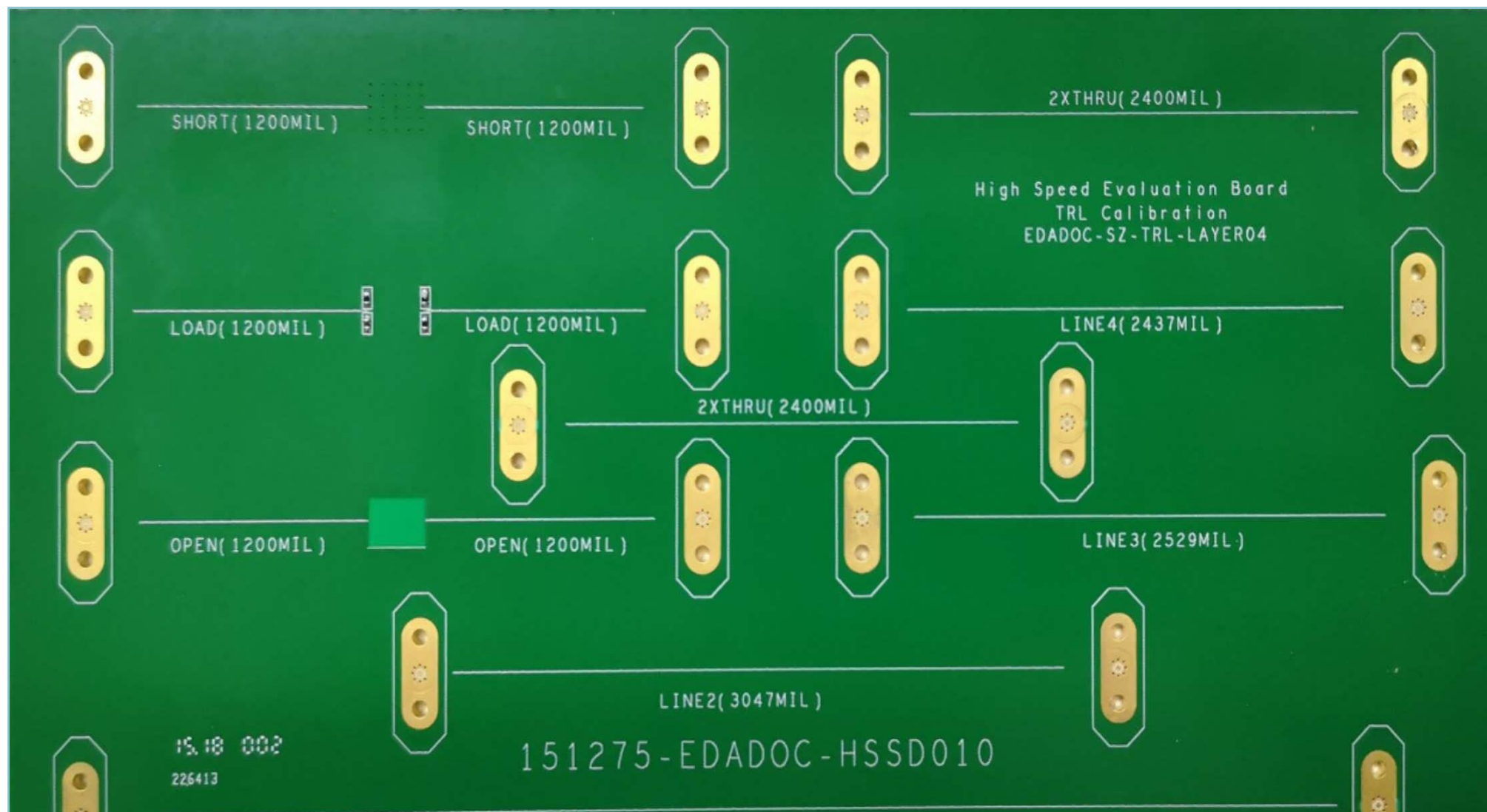


02

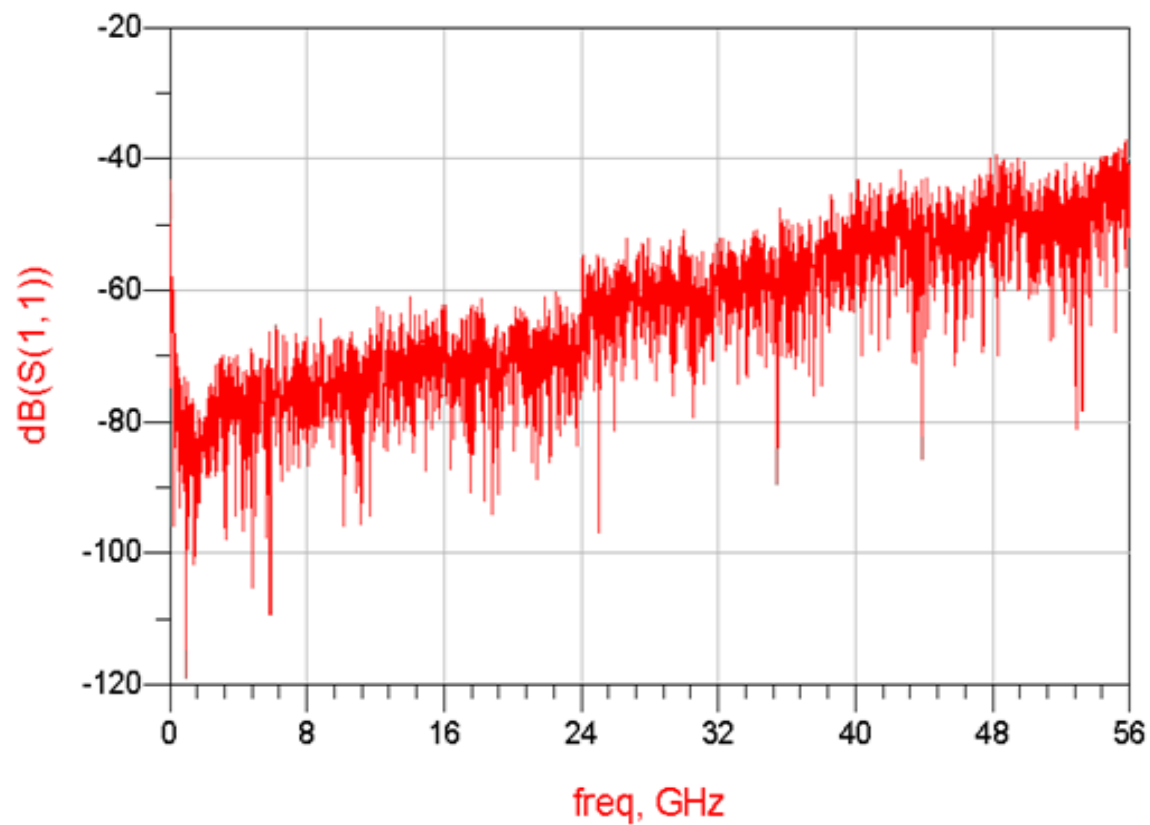
无源通道测试及校准



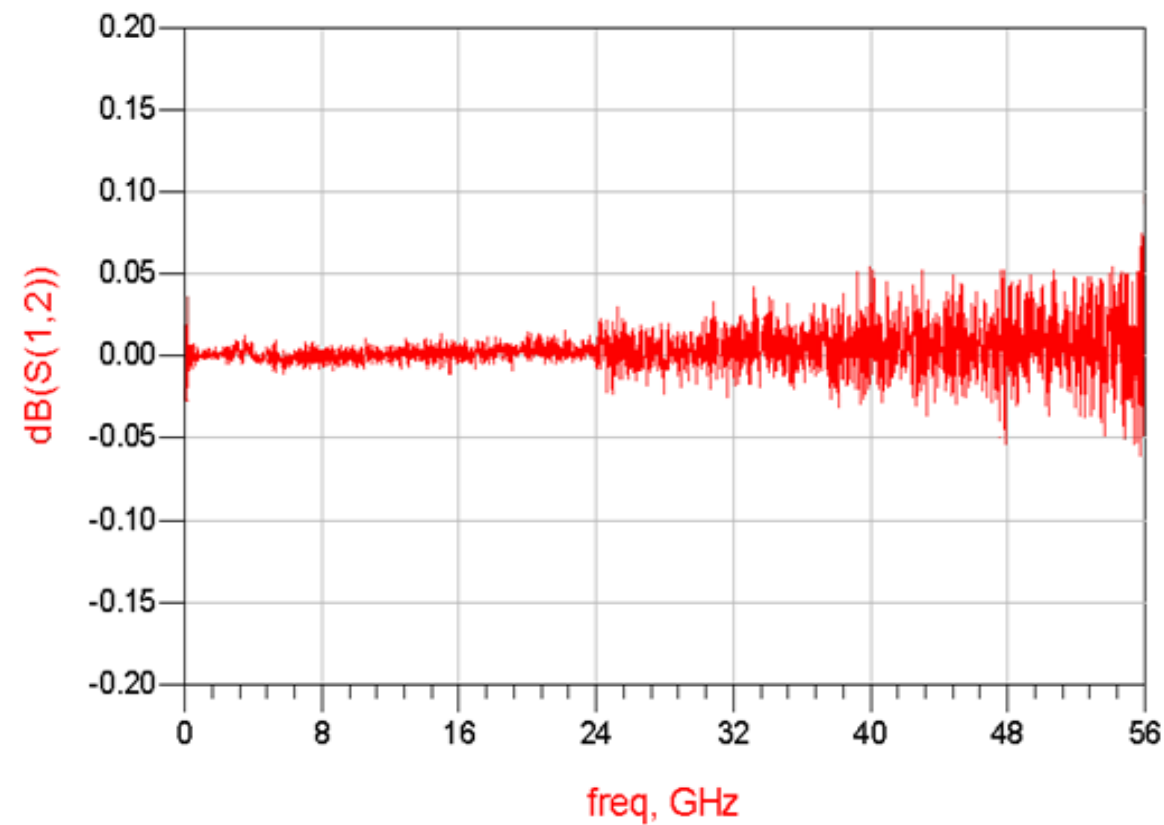
TRL校准件设计



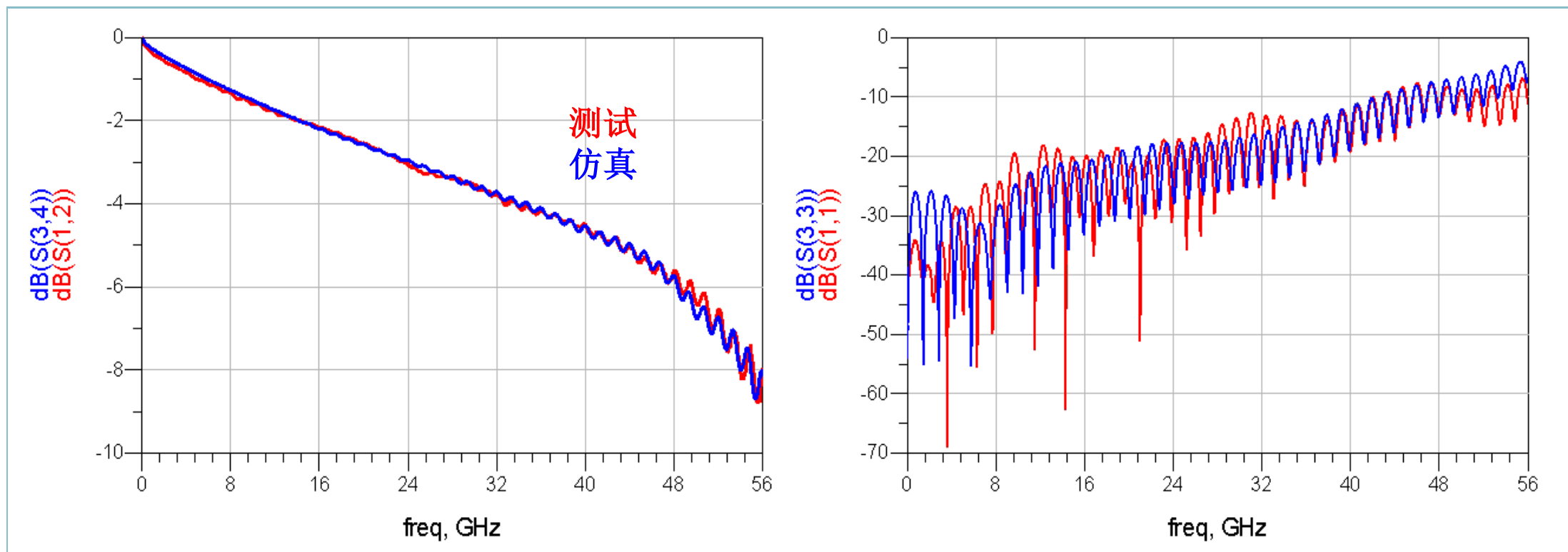
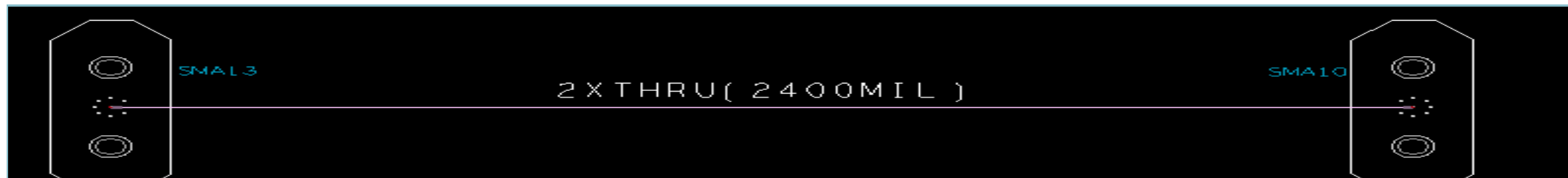
回损



插损

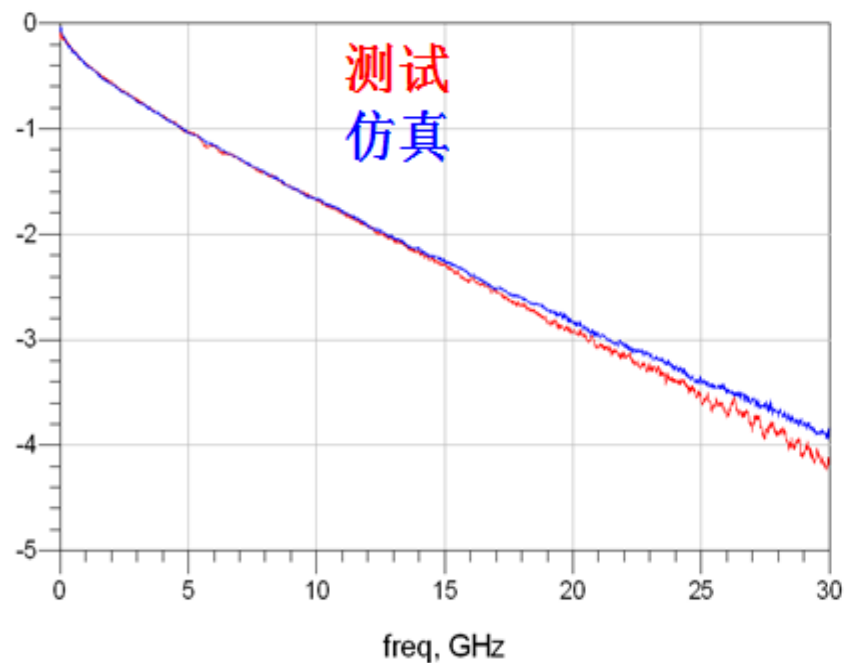


SMA头仿真测试仿真校准

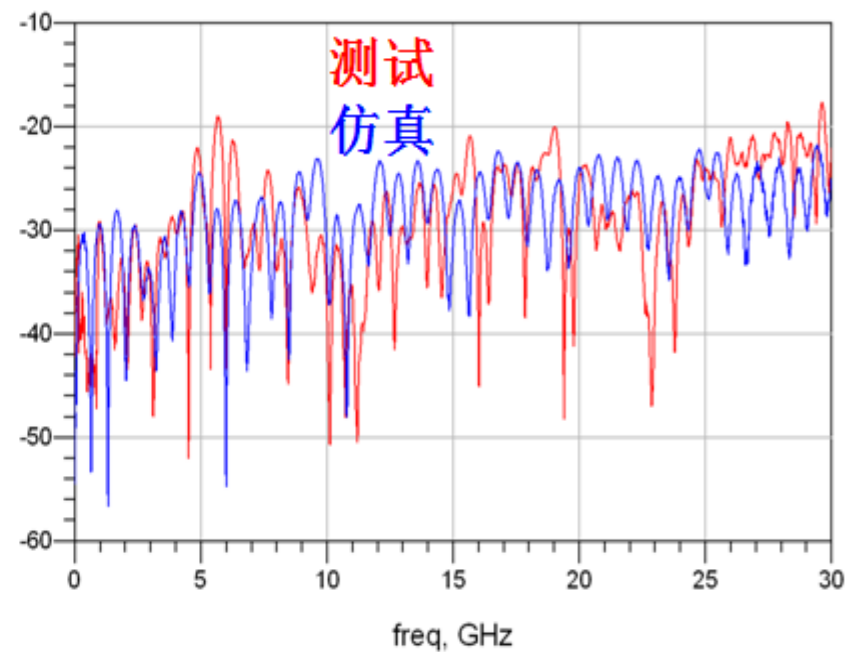


ultra low loss material TU 933

Insertion loss

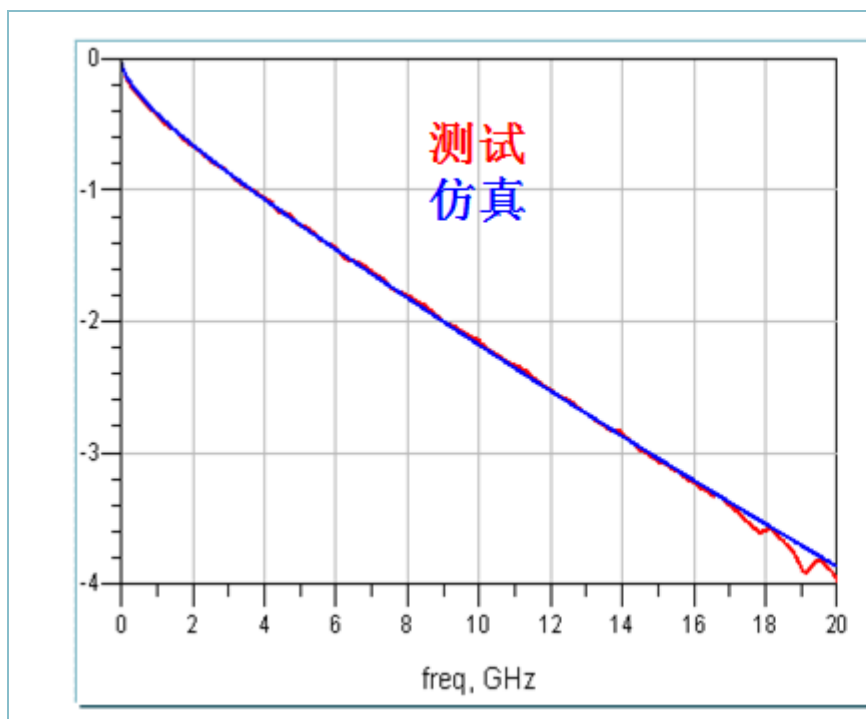


Return loss

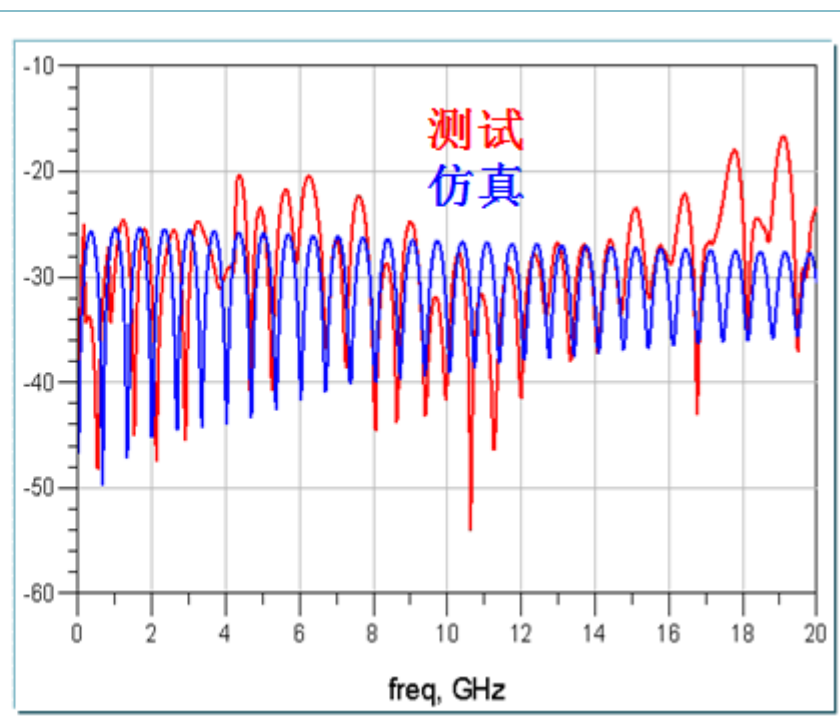


Very low loss material IT968SE

Insertion loss

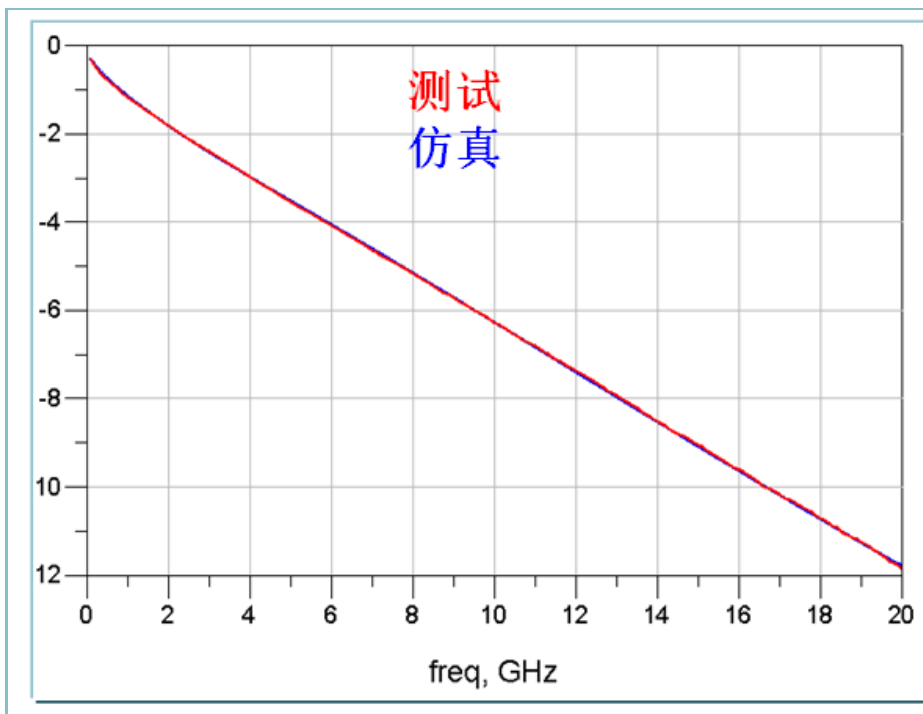


Return loss

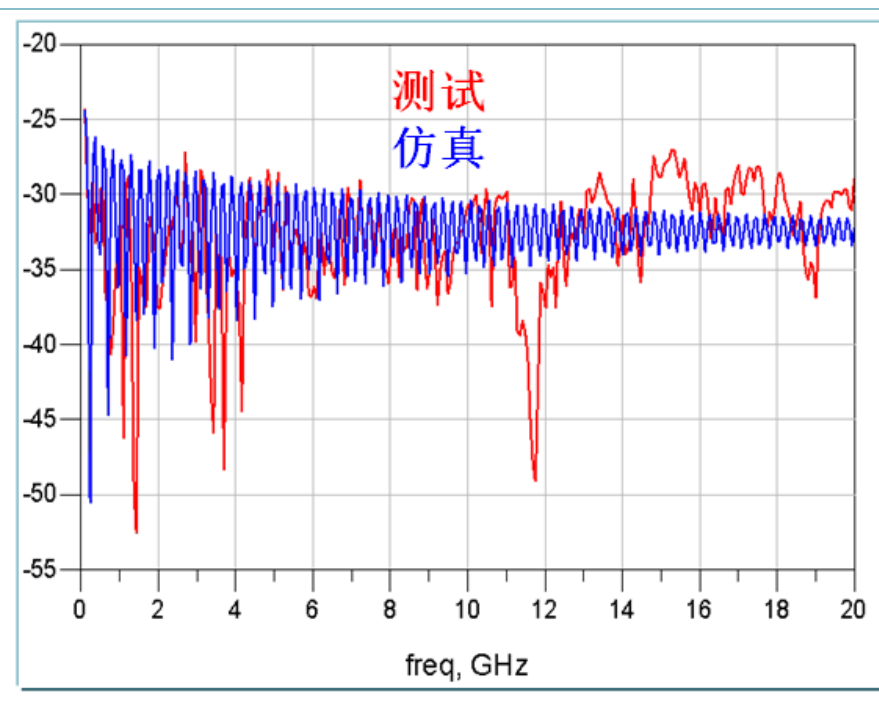


Very low loss material M6G

Insertion loss

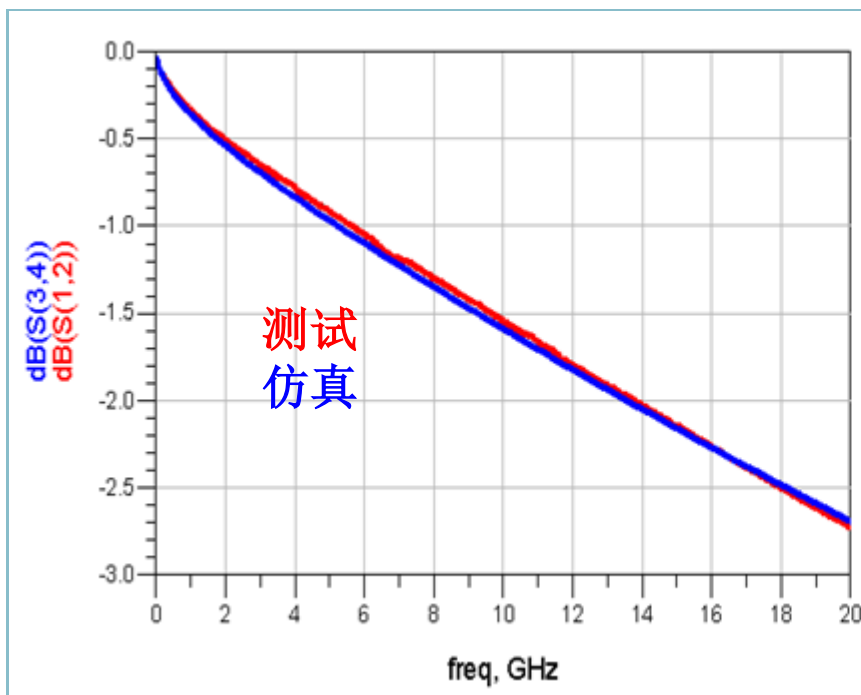


Return loss

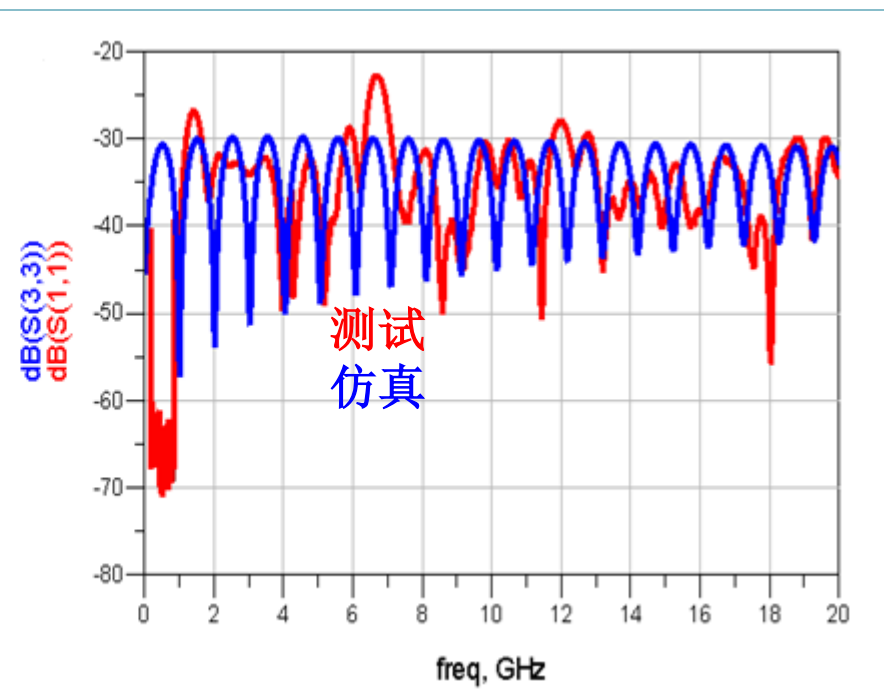


Very low loss material IT988SE

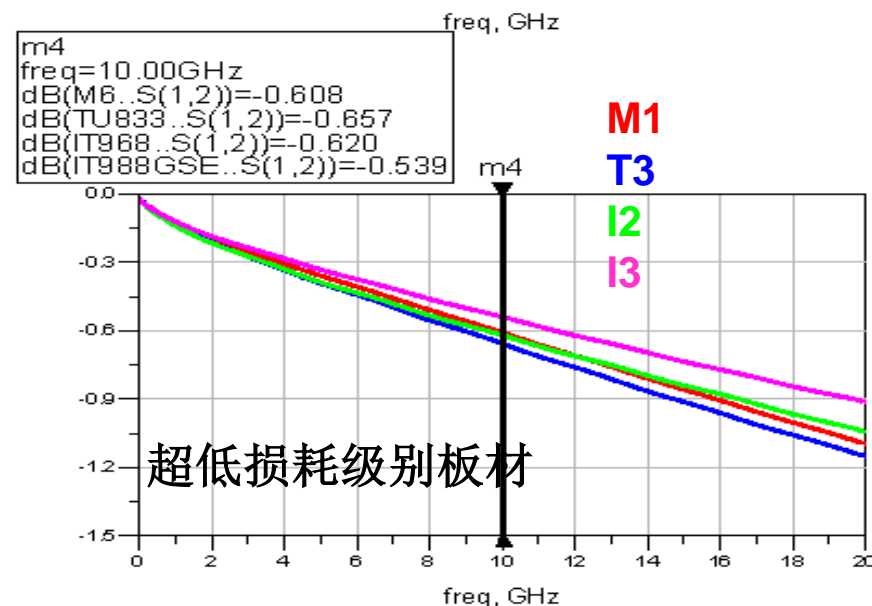
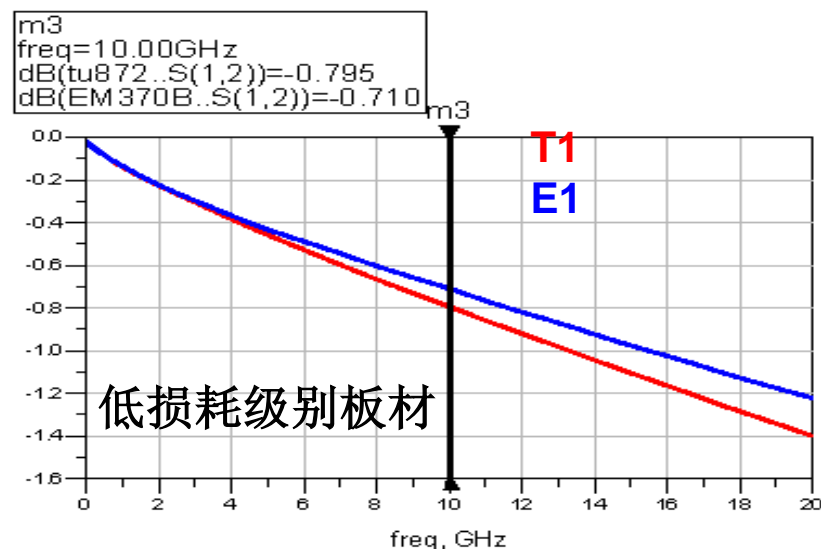
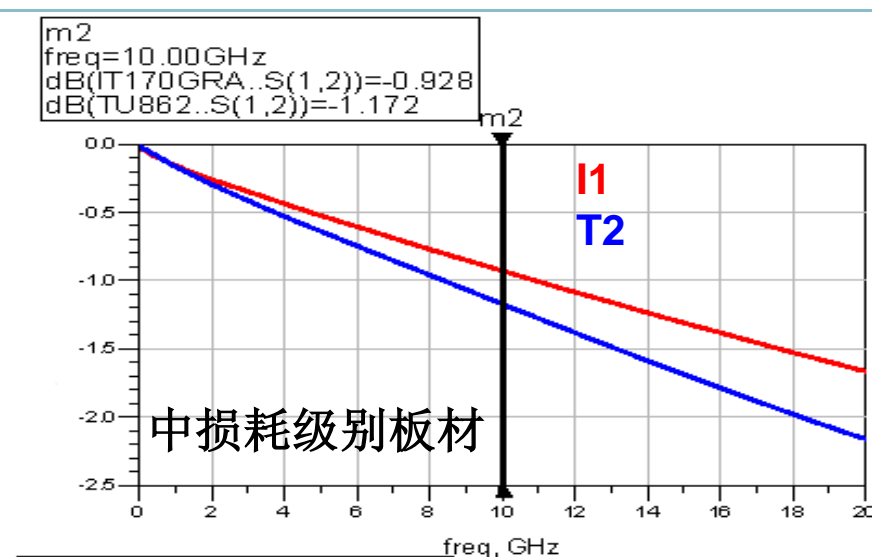
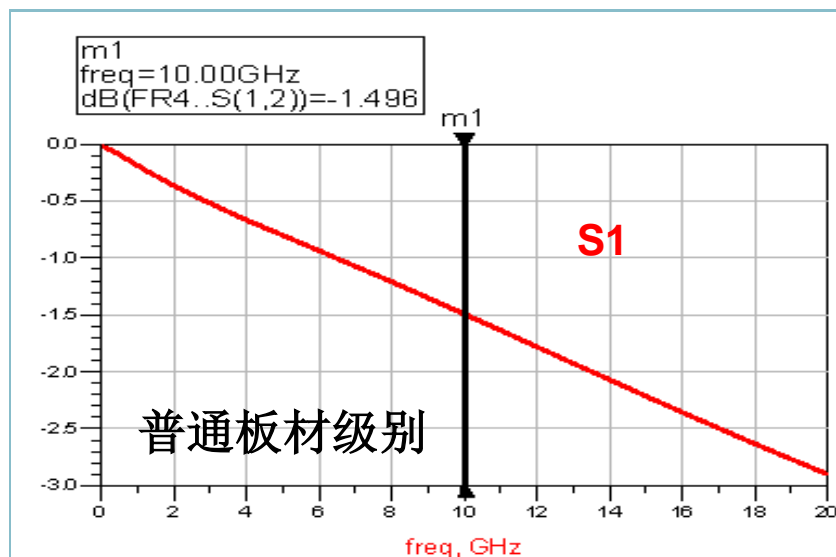
Insertion loss



Return loss



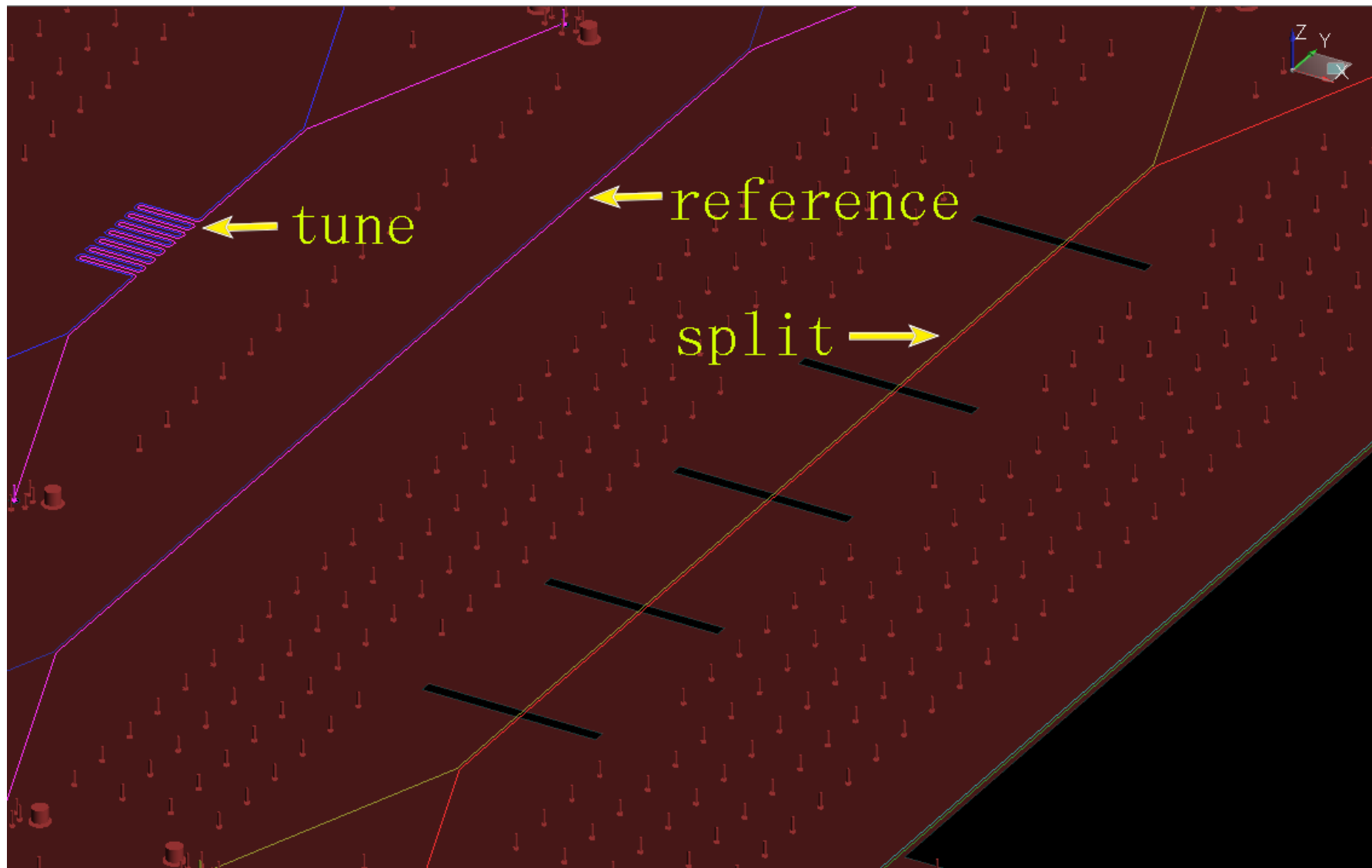
不同板材损耗对比



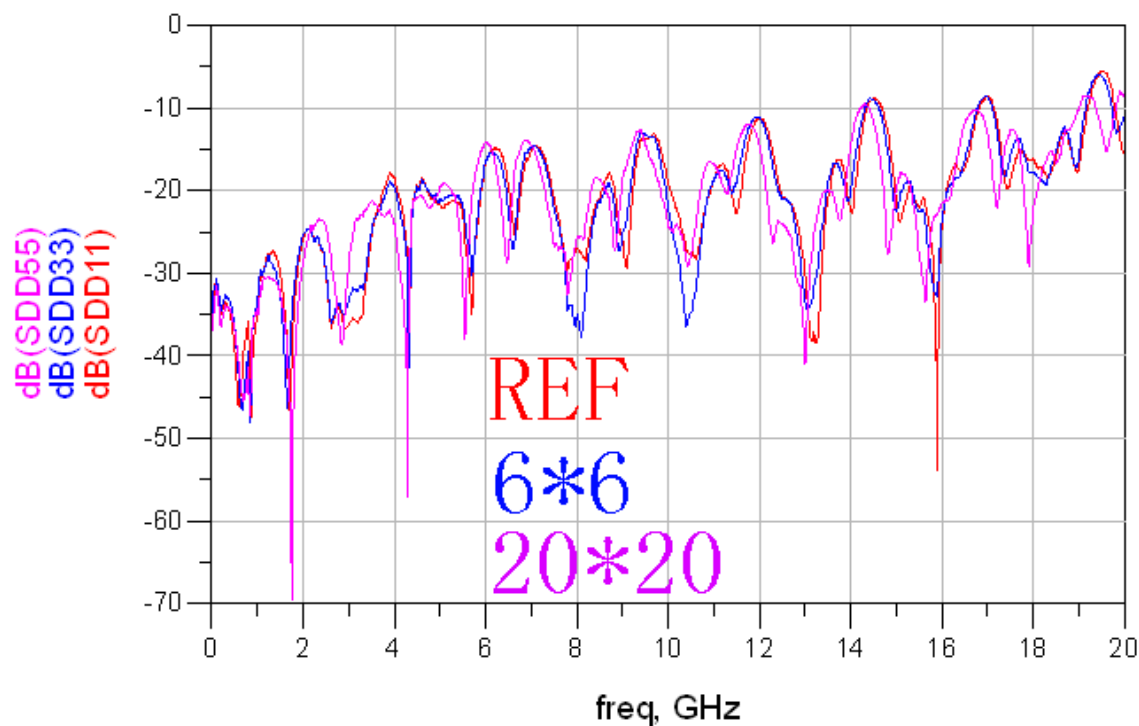
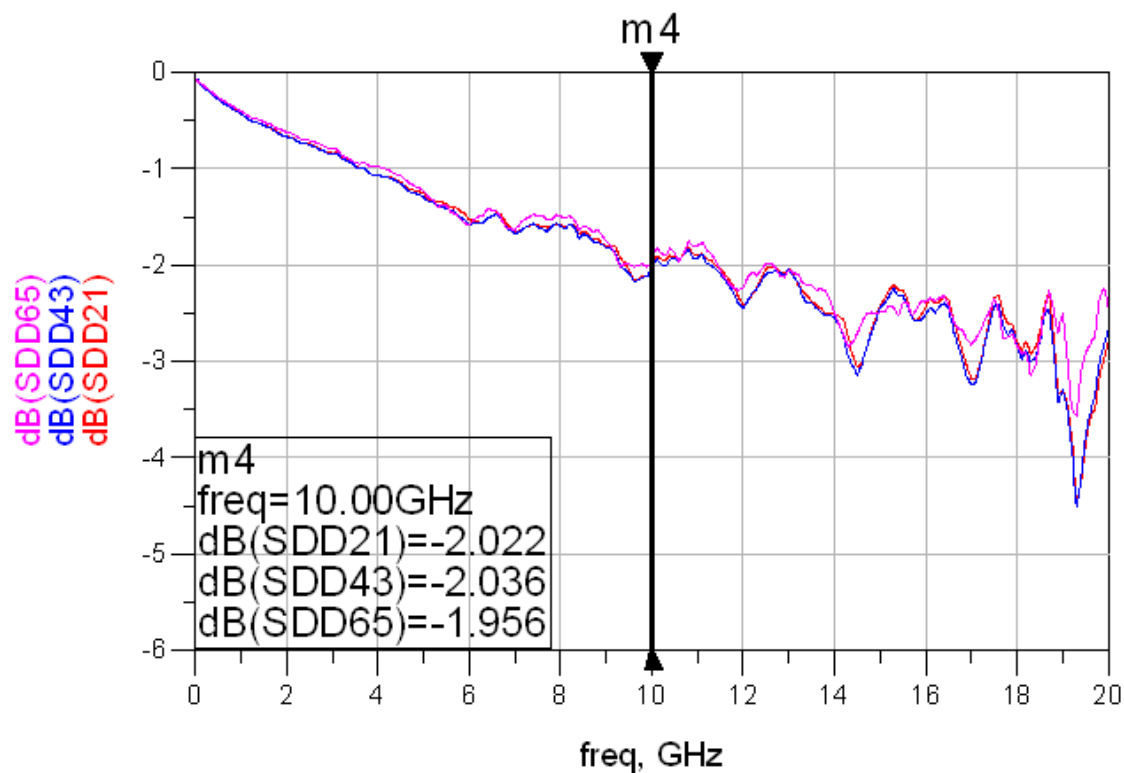
03

仿真测试校准

测试DUT介绍

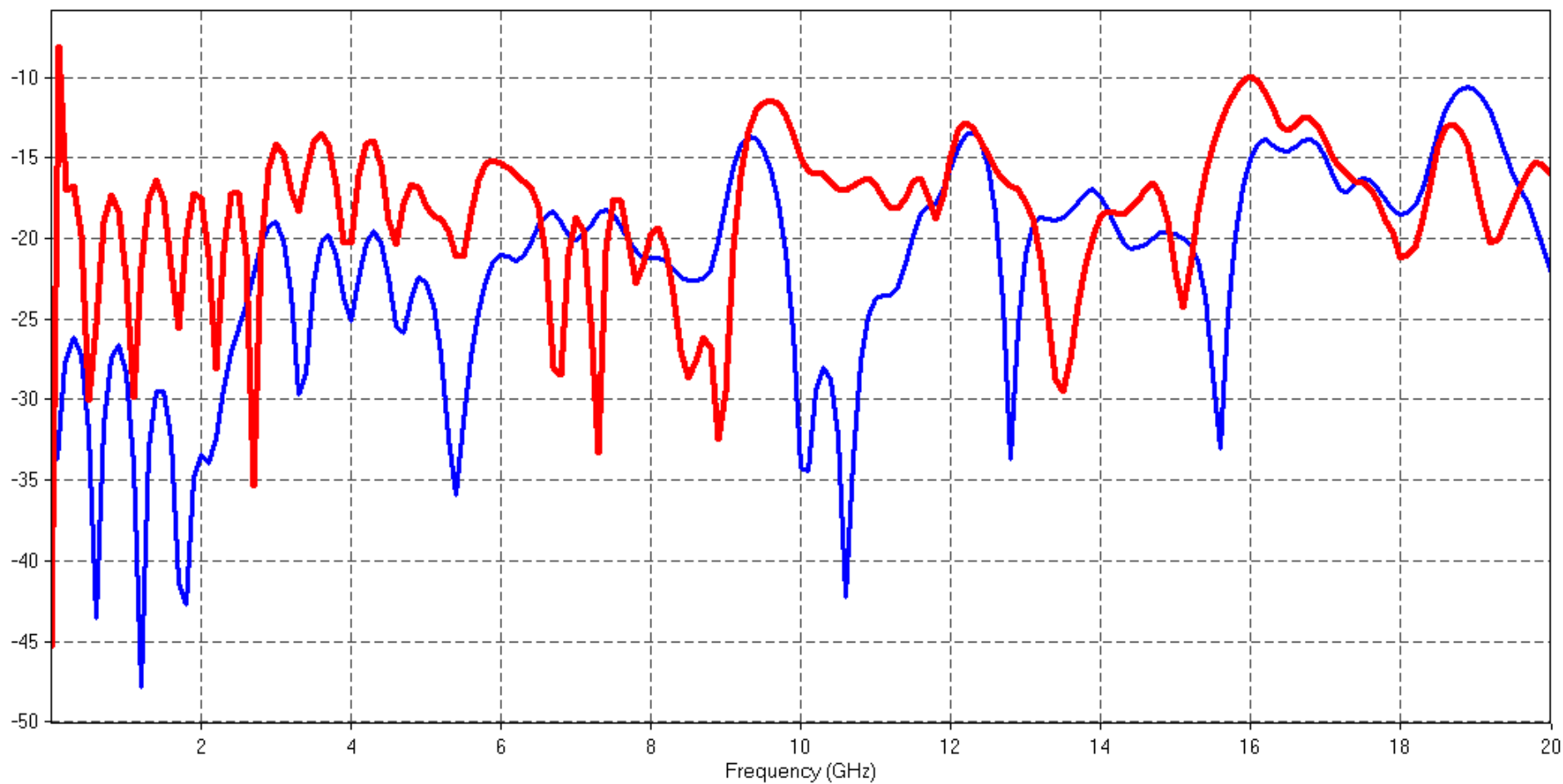


测试结果展示



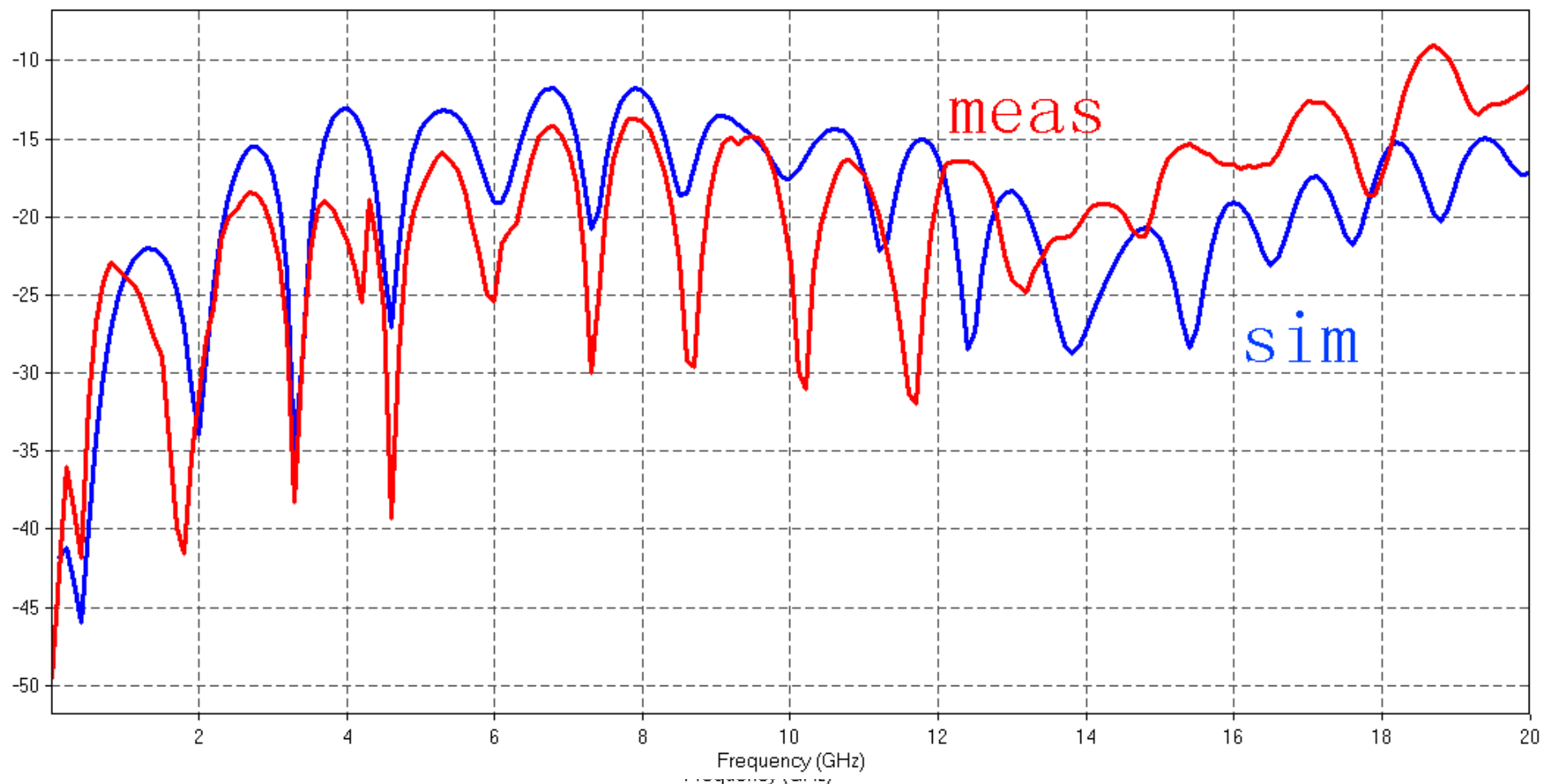
S Amplitude (dB)

Diff - Diff



SA S Amplitude (dB)

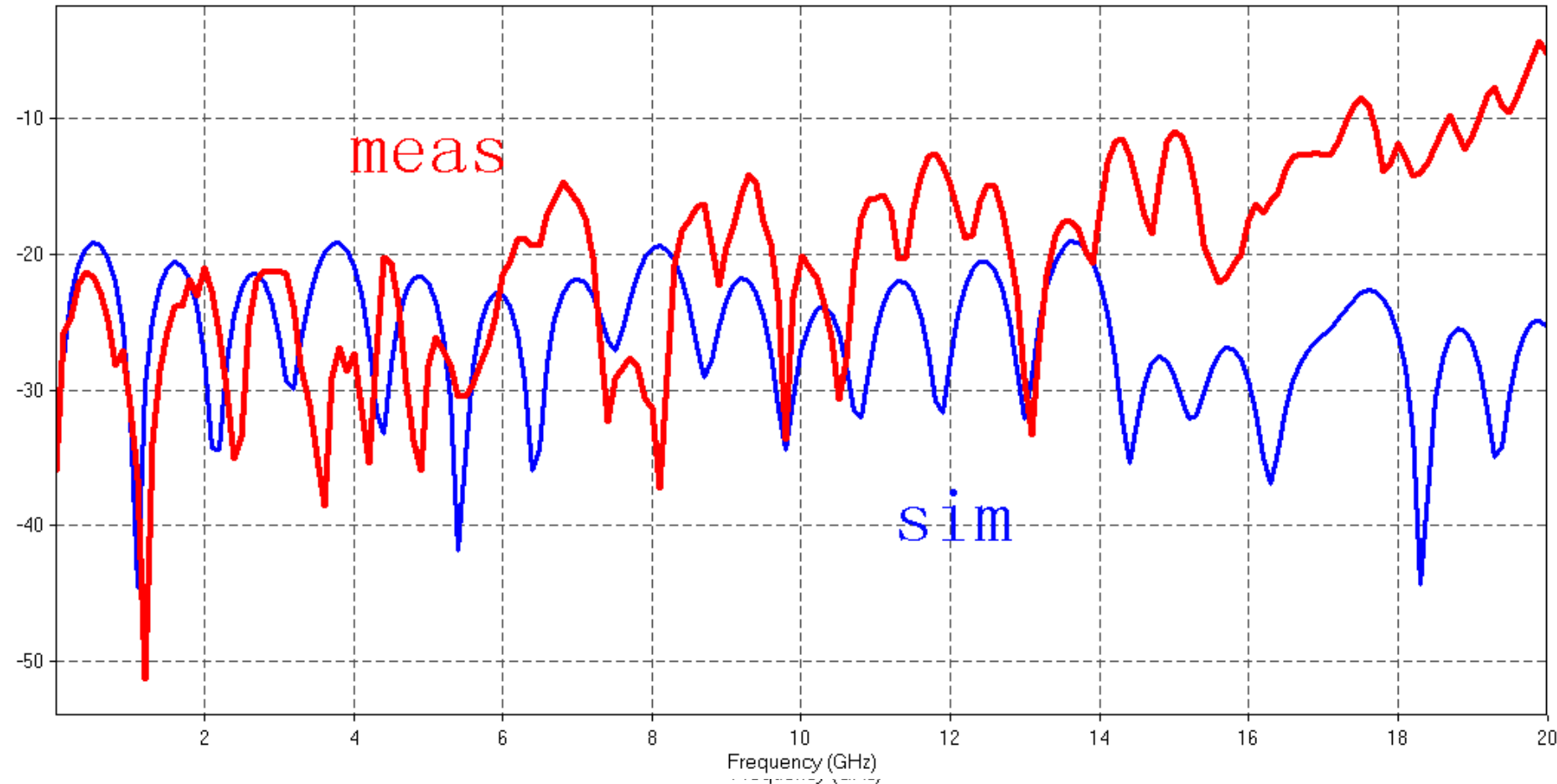
split.spd



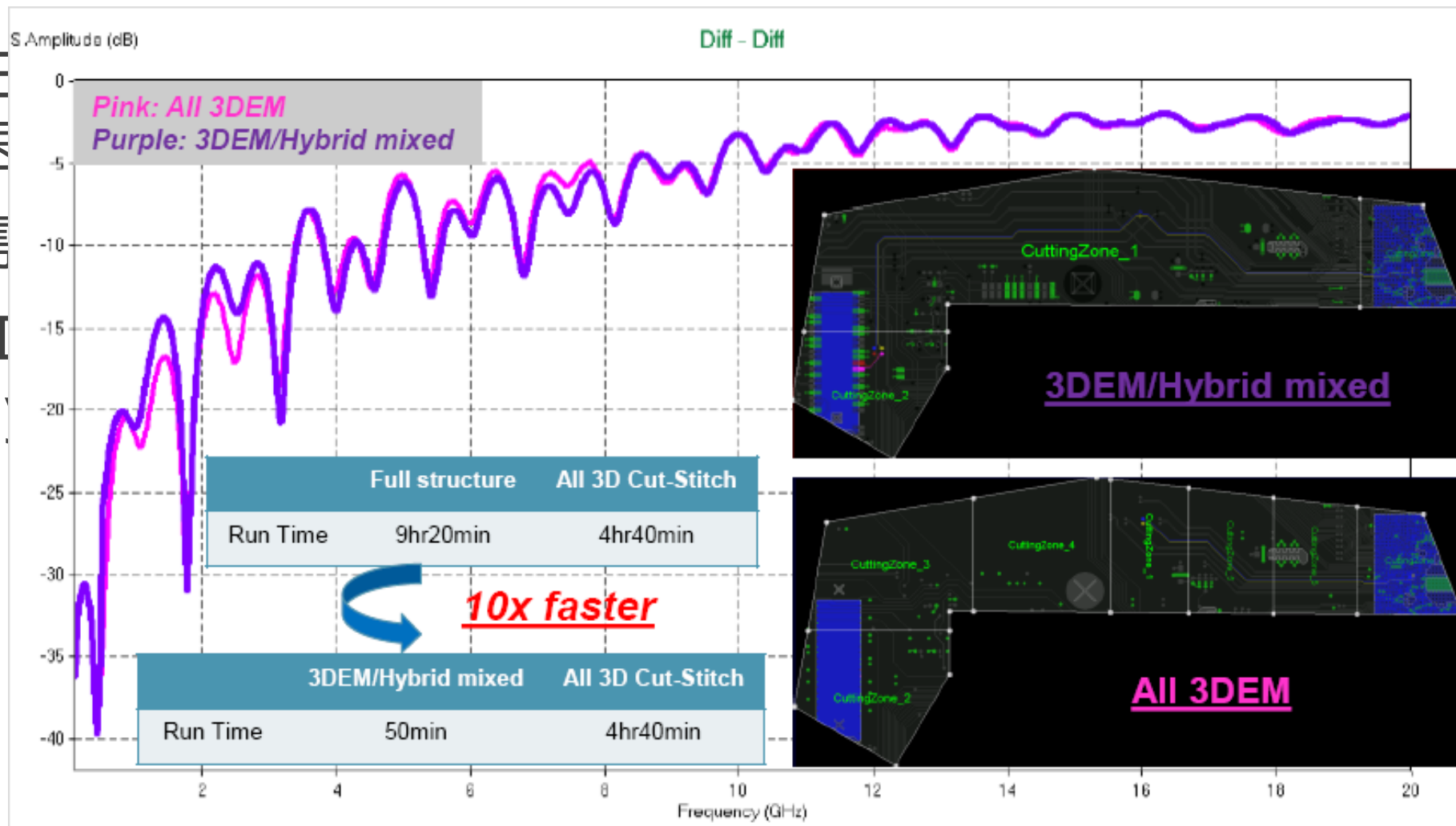


S Amplitude (dB)

FPC_2020.spd

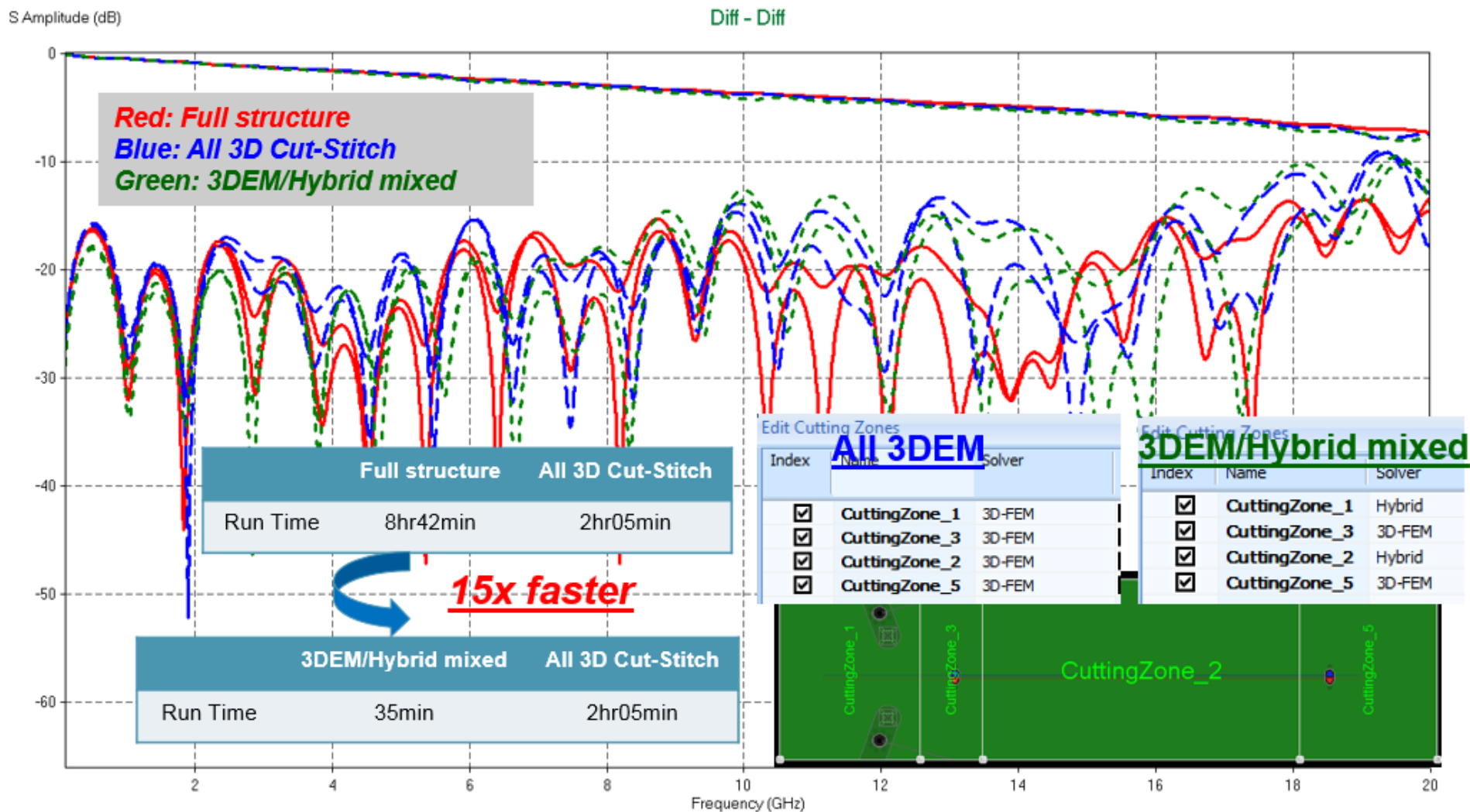


- 三速
- 需
- 3D H



真迭代的

分使用

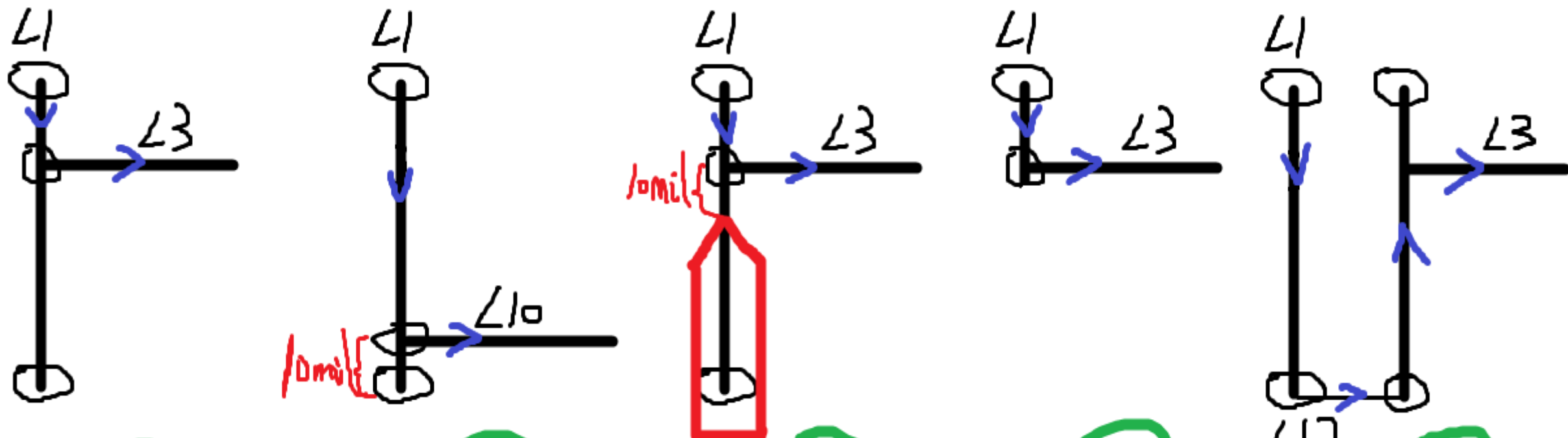




04

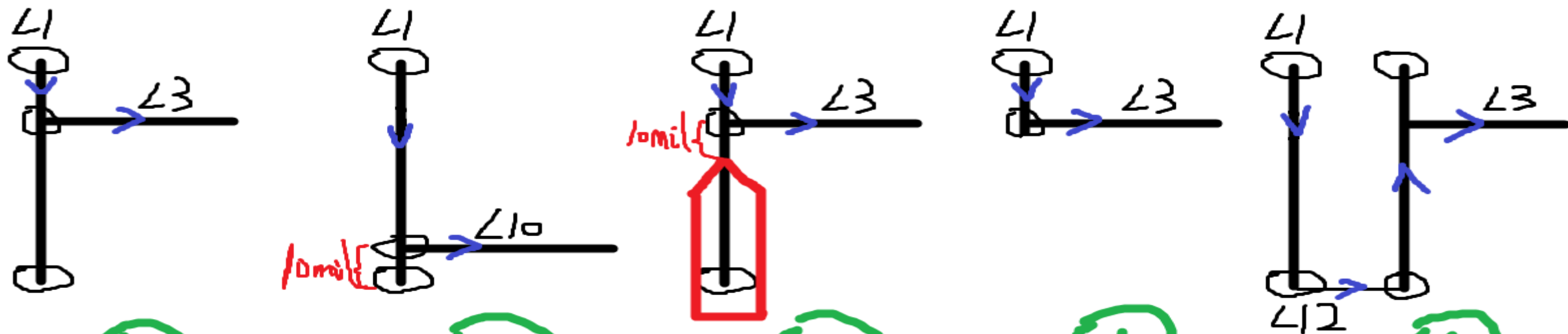
应用实例

案例一：关于过孔的比较



4 > 3 > 2 > 5 > 1

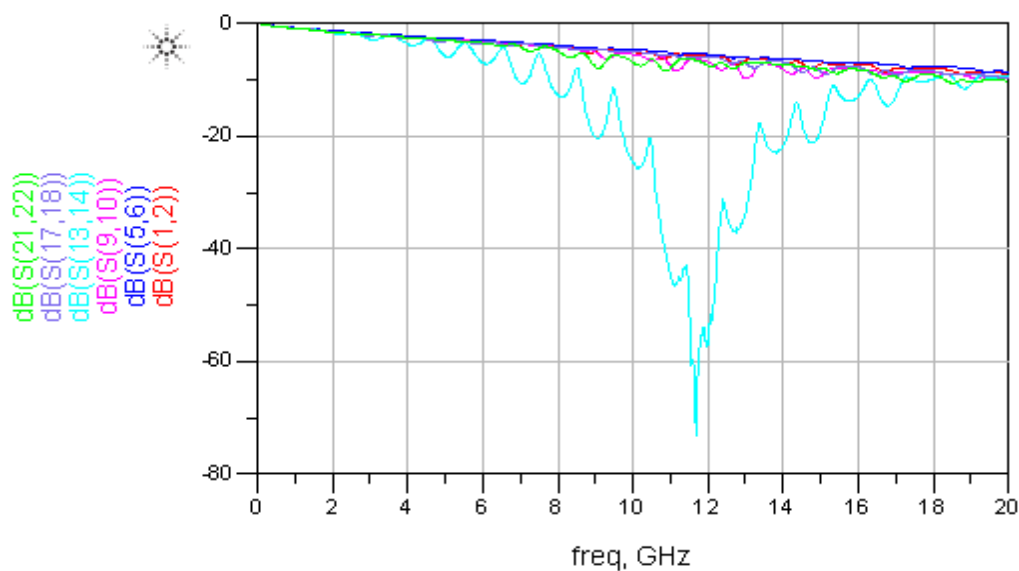
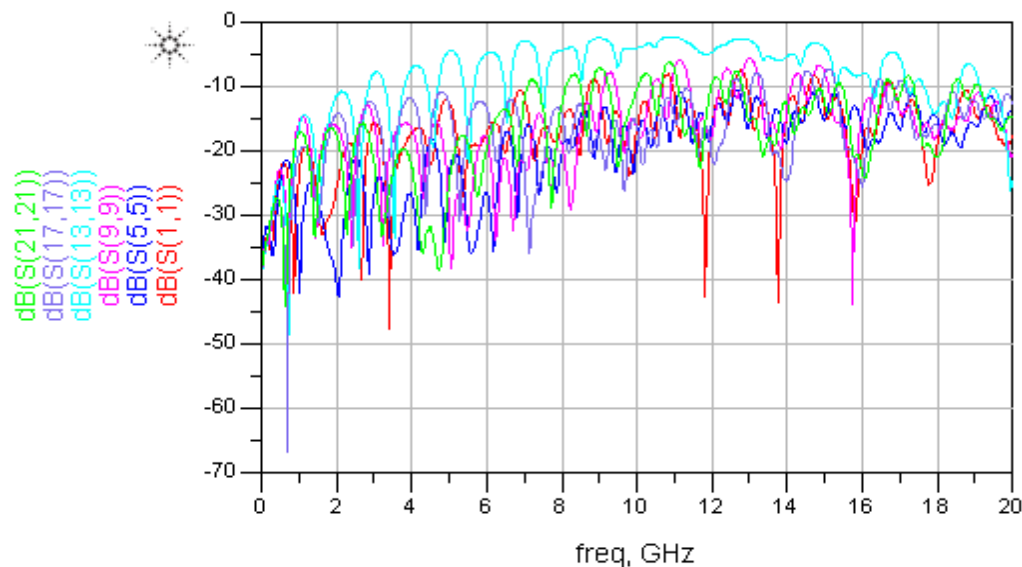
关于过孔的比较

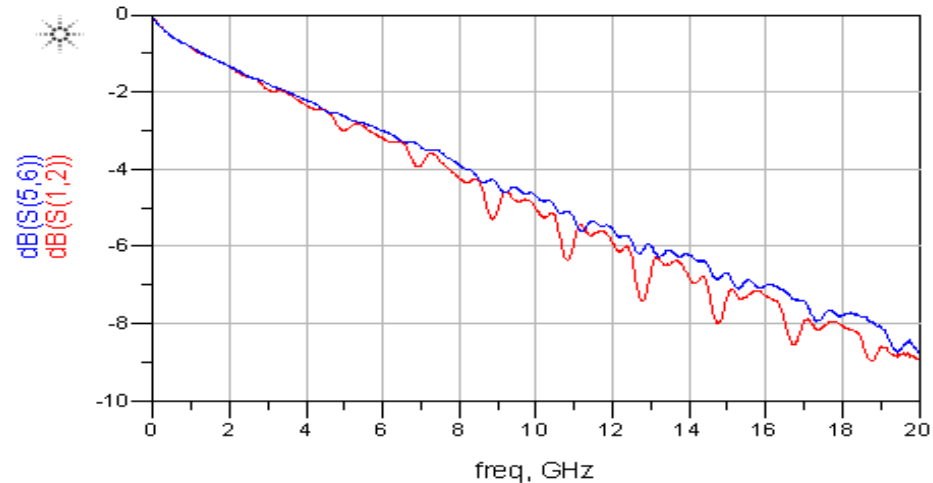
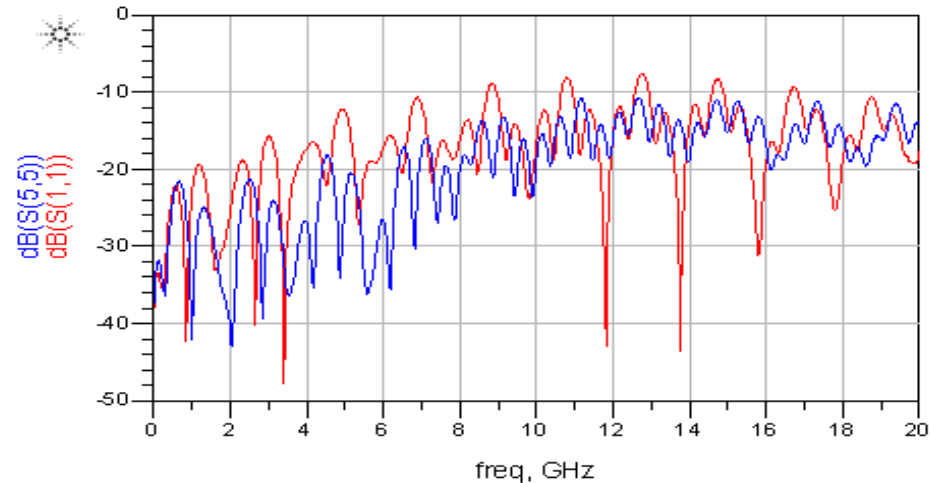


4 > 3 > 5 ≈ 2 ≈ 1

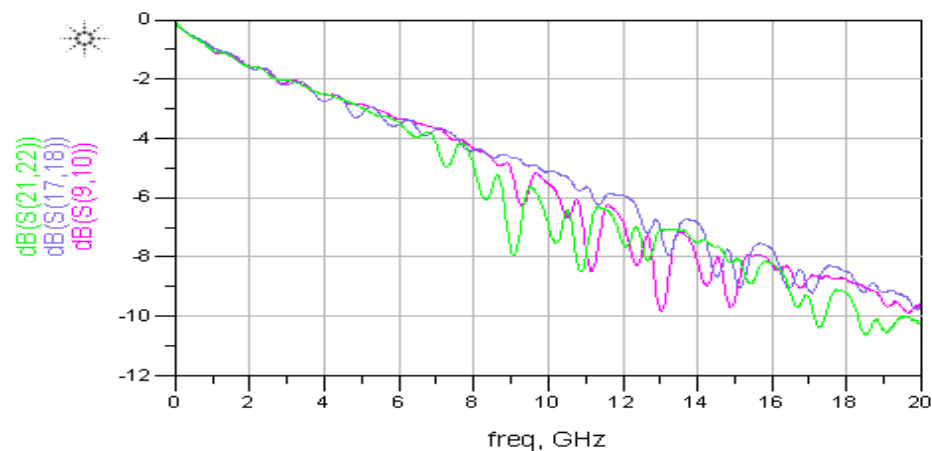
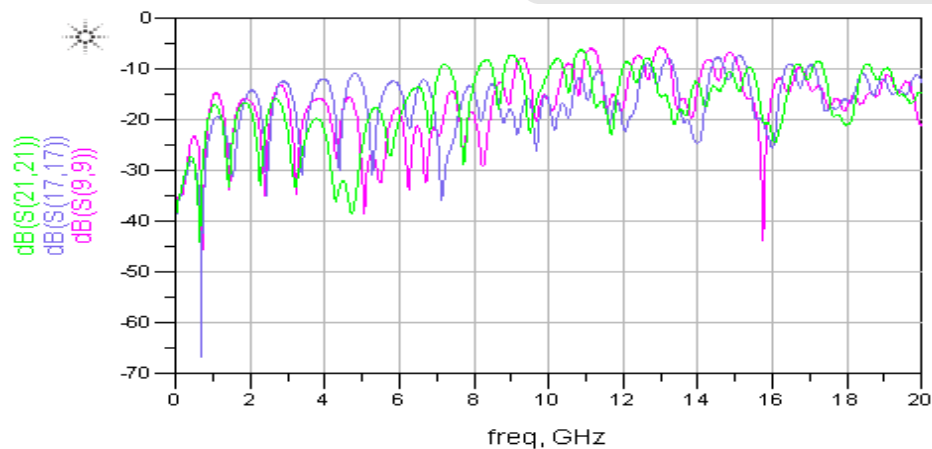
过孔研究 – 背钻、U-Turn等

- 表层到10层，长孔无背钻
- 表层到3层，短孔，残桩长，背钻
- 表层到3层，100mil_U—turn
- 表层到3层，短孔，残桩长，无背钻
- 表层到3层，35mil_U-turn
- 表层到3层，200mil_U-turn





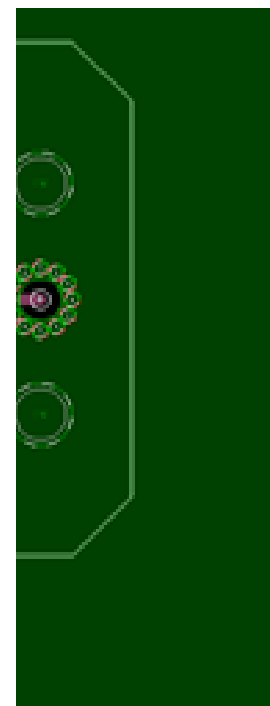
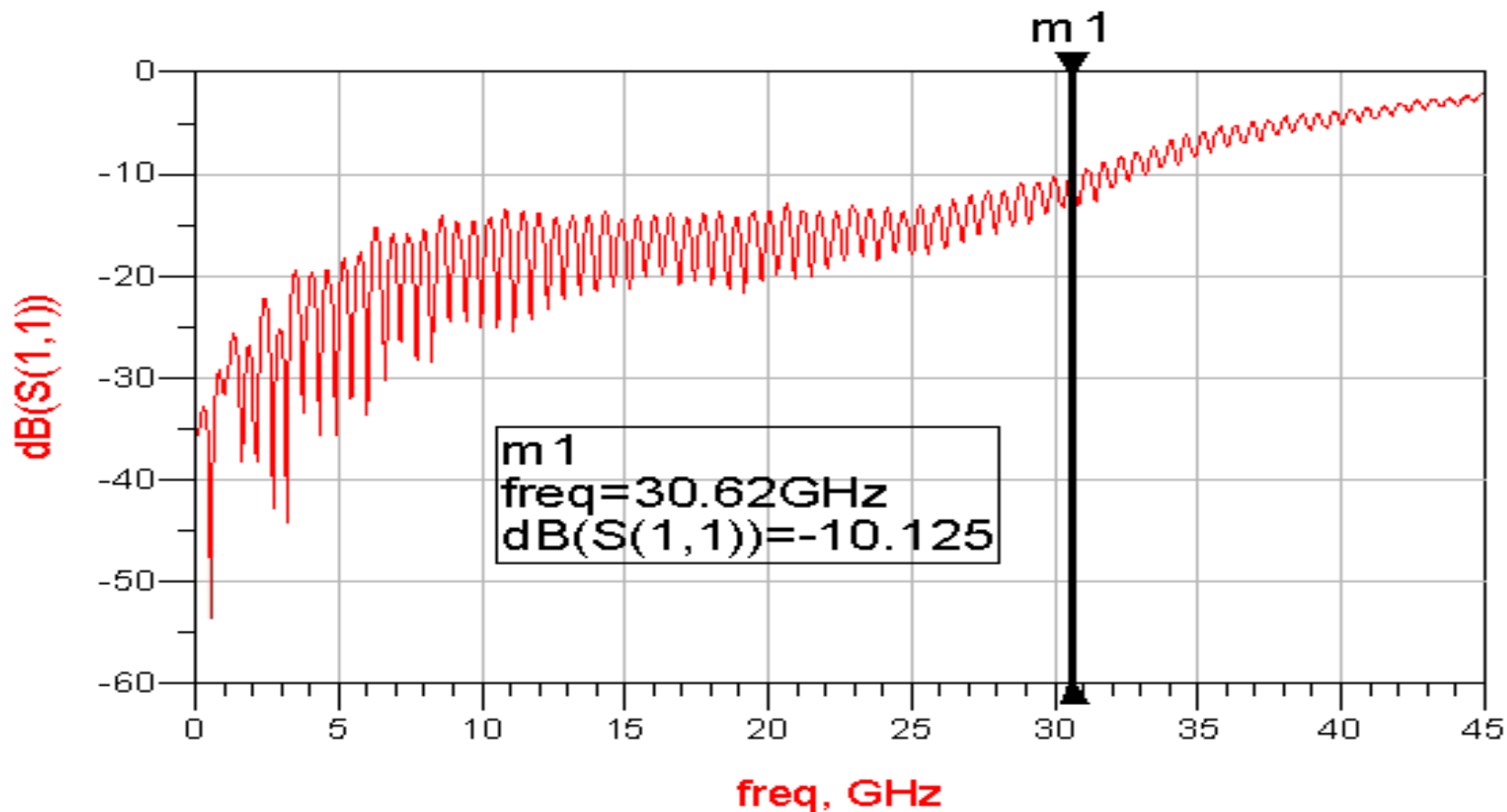
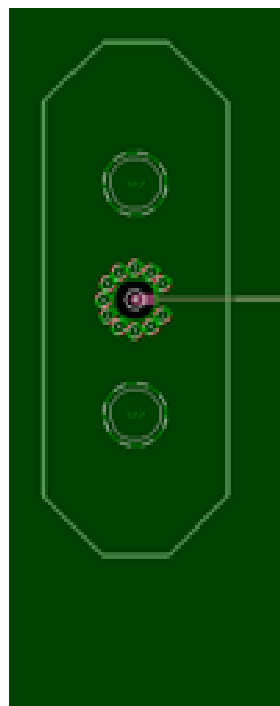
表层到10层，长孔无背钻
表层到3层，短孔，残桩长，背钻



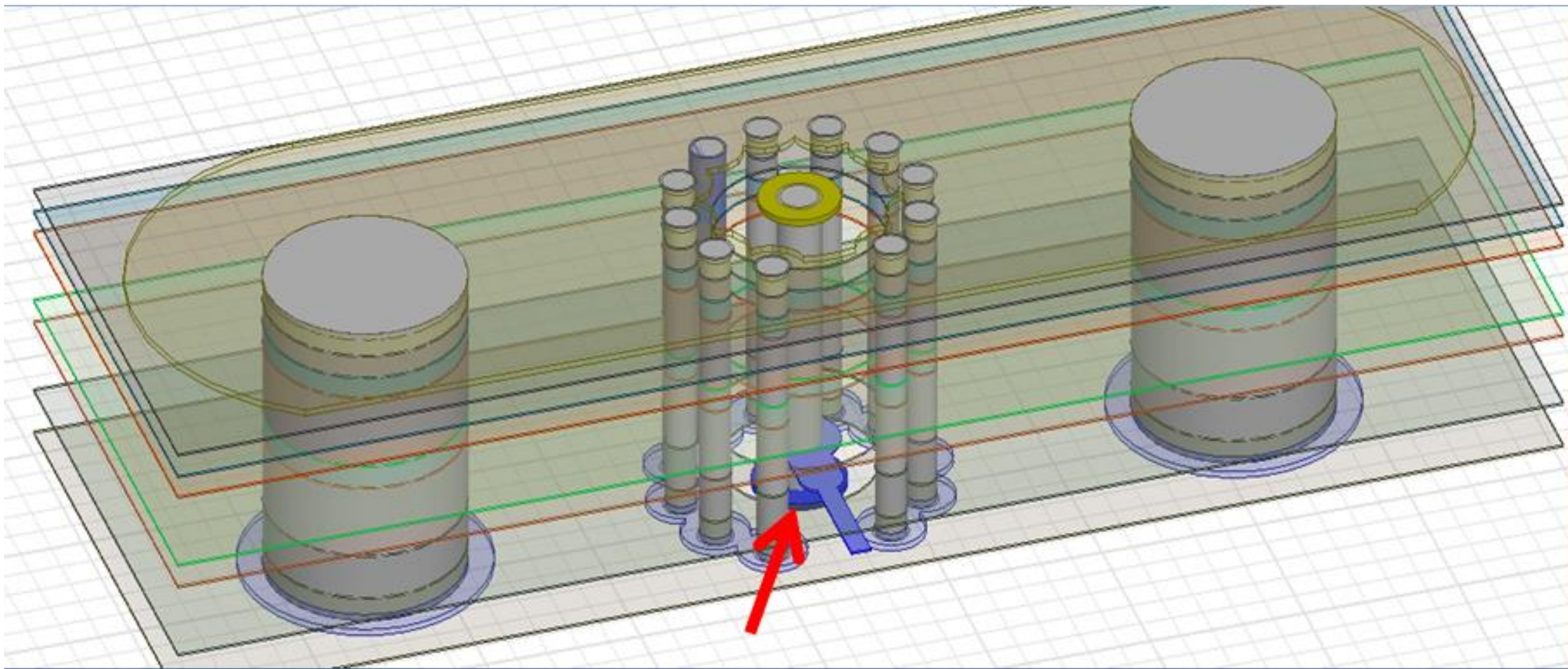
表层到3层，100mil_U—turn
表层到3层，35mil_U-turn
表层到3层，200mil_U-turn

案例二：SMA处测试结果

- 测试以下结构，发现回损过大，在30GHz已经达到-10dB。

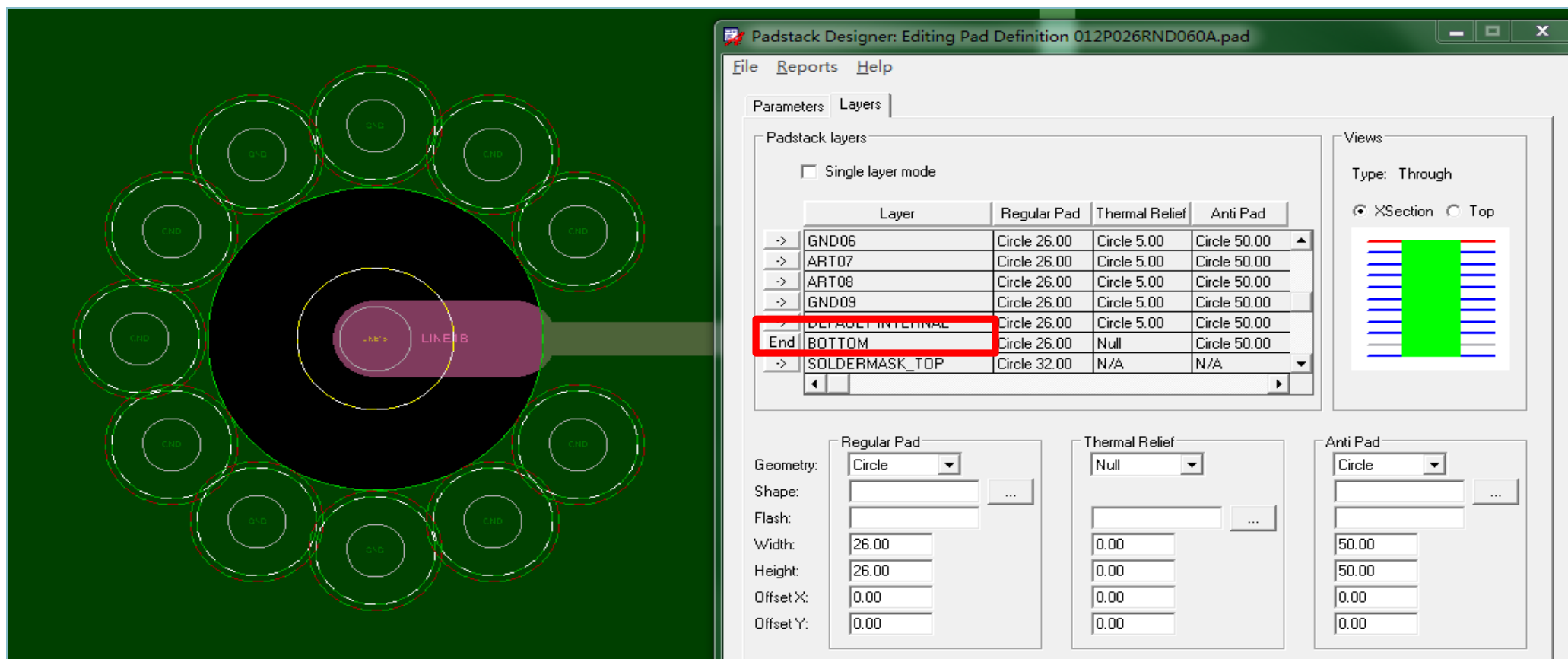


- 从模型上看出，除了过孔的stub之外，还有水平方向上焊盘的stub。

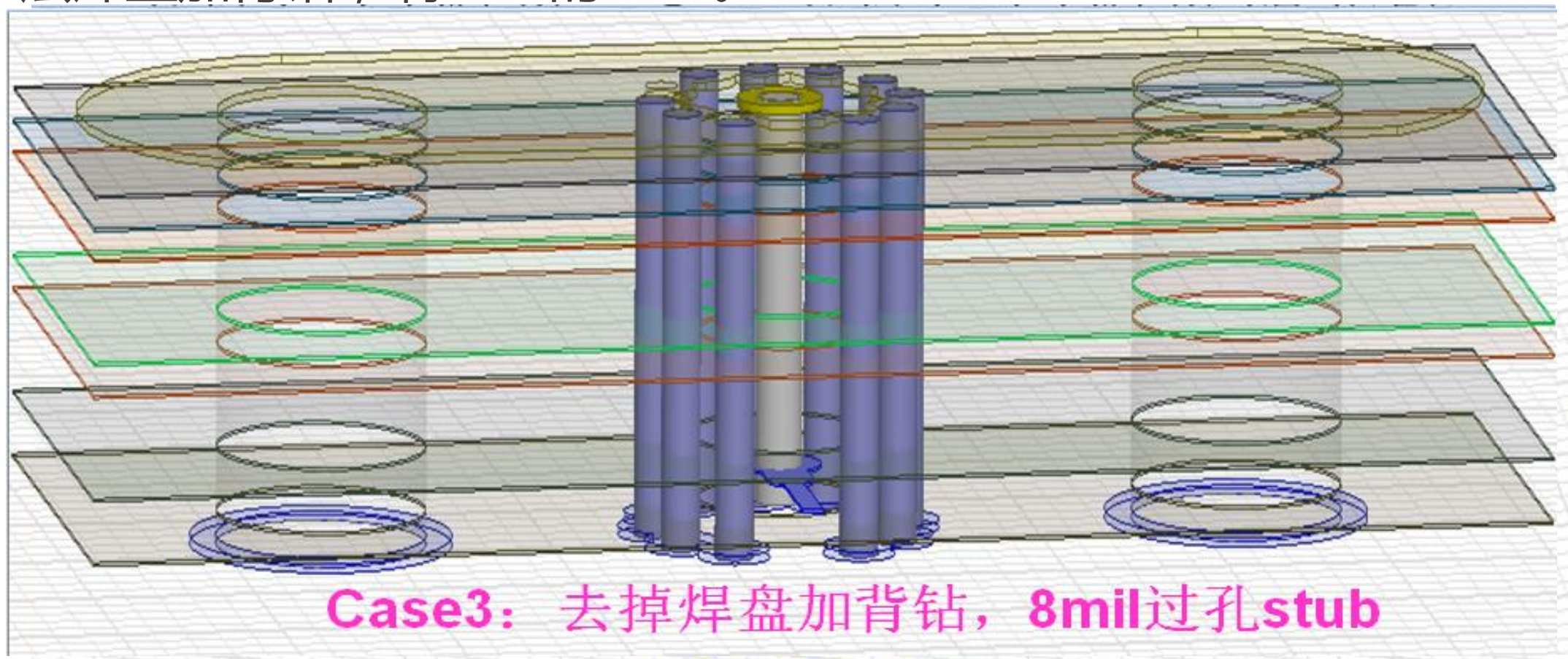


意料之外的Stub

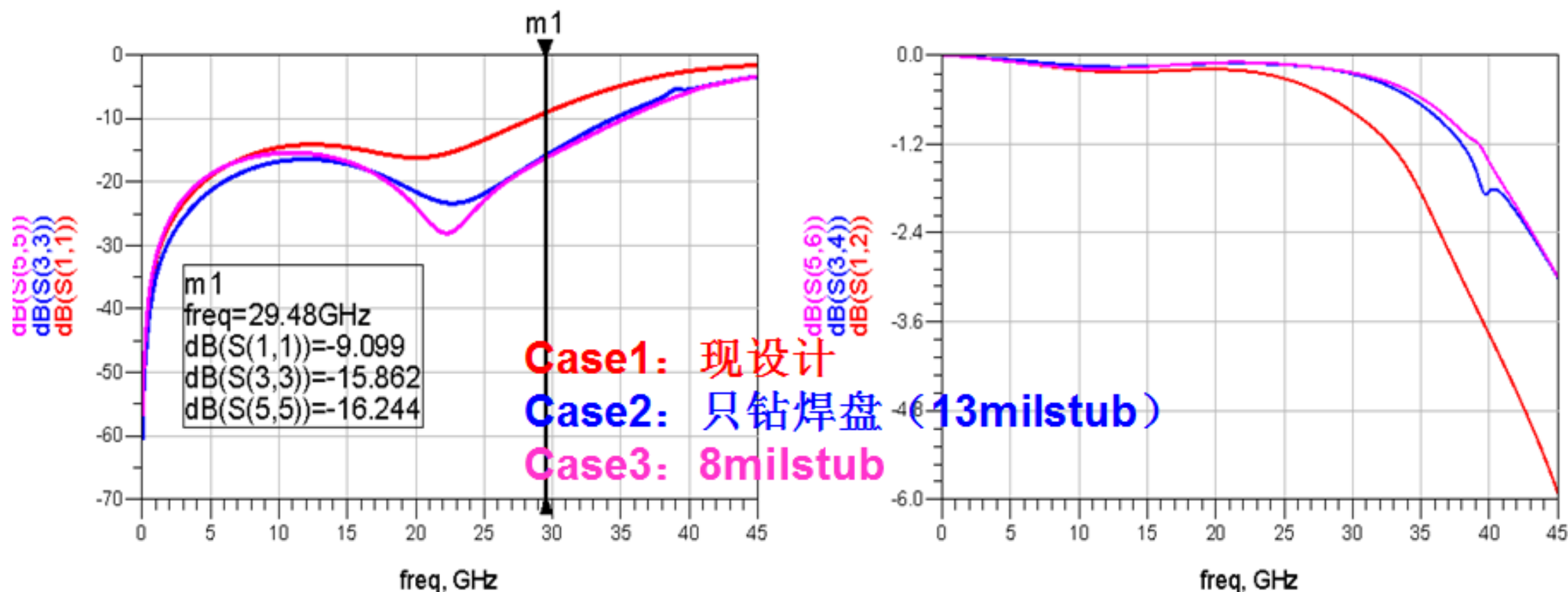
- 从模型上看出，除了过孔的stub之外，还有水平方向上焊盘的stub
- 底层的焊盘半径为13mil，过孔的半径为6mil，因此理论上至少还多7mil的stub。



- 仿真对比三种情况：1，现在的设计；2，去掉底层焊盘；3，去掉底层焊盘加背钻，剩8mil的stub。



- 结果如下所示：焊盘的影响非常严重，焊盘大的话不仅是增加stub，而且自带容性效应，阻抗也拉低很多，回损急剧恶化。



05

总结

- 精确的测试才能对设计与仿真提供真正有指导意义的结果。使用TRL校准可以大幅提高测试结果的精度
- 精确的仿真可以提高设计的效率，提升仿真精度需要测试校准
- 并行分布式计算可以大大提高仿真的效率，并且保证结果的精度



Thank You!